

Busy As Bees

Ukrainian payload specialist, students in America, Ukraine share growing experience

High school students from the United States and Ukraine took advantage of a rare opportunity to interact with astronauts aboard the Space Shuttle *Columbia* who were conducting plant science experiments during the STS-87 mission.

While the students built simulated flight hardware and studied plant growth, pollination and fertilization of the *brassica rapa* plant in their classrooms, the same plant investigation was taking place in the microgravity environment aboard the shuttle.

The educational activities, a significant component of the Collaborative Ukrainian Experiment payload, were known as Teachers and Students Investigating Plants in Space, or CUE-TSIPS.

"Last weekend, they were all here at the Kennedy Space Center for a wrap-up symposium," said Tom Dreschel, CUE education coordinator for KSC. "The teachers had a lot of good stories about their involvement. All the teachers felt it was a very good program. Every student that they had participating in the project got something valuable from it, learned something from the project."

Until recently, plants grown in space from seeds failed to produce new seeds. Astronaut Michael Foale, aboard the Russian Space Station Mir, used a new technique with a dead bee glued to the end of a toothpick to pollinate plants and successfully produced the first seed-to-seed experiment in microgravity. That same technique was replicated on the shuttle during STS-87 and in schools across the United States and Ukraine.

Dreschel, who worked closely with Principal Investigator Mary Musgrave of Louisiana State University and Paul Williams and Vladimir Nazarenko, the education coordinators for CUE, participated in the teacher workshops that preceded the in-flight activities and coordinated meetings between teachers and scientists. He said about 20 teachers gathered at KSC to share what each school did and early results of the Earth-bound plant growth.

"The combination of do-able classroom activities and the fact that the activities were tied to an experiment in the space shuttle really got the students involved," Dreschel said. "There was a whole range of how well the plants did. Some of the teachers said it was the poorest set of plants they ever grew, and some of them said they did quite well. It was a learning experience. The students were very excited by the fact that they were participating in a NASA experiment."

"We're getting the same feelings from the people in the Ukraine," he added. "We had nine students here from the Ukraine for the launch. They were just in awe of everything they saw there, and got to meet Ukrainian President Leonid Kuchma while they were here."

The CUE mission carried the first cooperative scientific payload between NASA and the National Space Agency of Ukraine. Payload Specialist Leonid Kadenyuk was the primary payload specialist and the first Ukrainian to fly aboard a U.S. shuttle.

On Dec. 1, as part of the STS-87 mission events, Ukrainian students and American students participated in 30-minute downlink session from

the shuttle and studios at JSC, Kennedy Space Center and Kiev, Ukraine, asking questions about similarities and differences in the way the plants grew on orbit and on the ground.

Dreschel said the teachers both in the U.S. and the Ukraine were extremely enthusiastic, and that the downlink events both in America and the Ukraine went well, covering many of the same questions. The Ukrainian downlink was conducted entirely in the students' native language.

Questions ranged from whether the plants and their blossoms remained the same on orbit as on Earth to whether Kadenyuk was having the same trouble keeping his bees used to help pollinate the plants attached to the sticks.

"We are finding a lot of variations in our AstroPlants," asked La Kendra Ross. "Are you finding this to be true with your plants on the shuttle?"

"We select the plants that are sent to the shuttle from a large number of AstroPlants," said Kadenyuk, who got a little help with his English from Commander Kevin Kregel. "We select plants which look the same to load into the PGCs. This step should minimize the variability of the plants in orbit."

Yolanda Benavidez asked whether the flower buds that were developing on the AstroPlant seed population arranged themselves in the "normal" spiral sequence up the stem. The answer: "Yes the flower buds develop the same as on Earth," Kadenyuk said.

"We always have bees that fall off our sticks. Has this problem been considered and how will you deal with it if it should occur?" asked Rebekah Serbin.

Kadenyuk's reply: "The bee sticks we use for flight are made with super glue and we select the best bee sticks for flight."

Yadira Medina wanted to know whether live bees would have trouble pollinating the plants in the space environment?

"Bees have been taken into orbit, but never with flowers, so their behavior in microgravity for pollination has not been studied," Kadenyuk explained. "The bees flown before were in small containers which did not allow detailed observation of their ability to fly in microgravity."

From KSC, Sarah Sherwood asked: "In space, do the roots of the plants grow down and the leaves grow up?"

"The plants grow toward the light and the roots grow away from the light," Kadenyuk said. "Sometimes we see roots start to grow up out of the foam, but they will turn back into the foam to avoid the light and reach the nutrient solution."

Early inspection of the plants grown on orbit show the result of some higher than anticipated temperatures, Dreschel said, but "in the chambers where the temperatures were closer to optimal, it appears the plants were normal."

Musgrave is still in the process of evaluating the data, he said, and comparing the height measurements of Earth-grown plants with those grown on orbit. More data on how the student plants fared is amassing.

CUE-TSIPS was sponsored by NASA Headquarter's Life Sciences Division and Education Division. □



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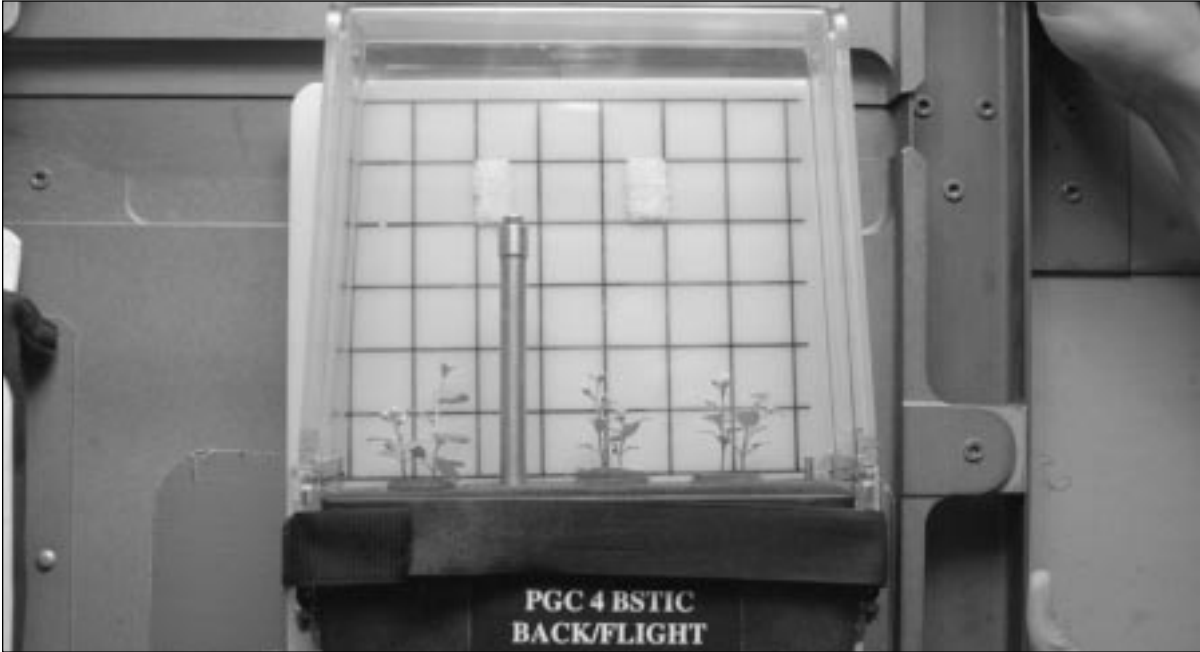


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Top: Students gather in Bldg. 2 at JSC to pose their questions to Ukrainian Payload Specialist Leonid Kadenyuk, watching and listening as he and STS-87 Commander Kevin Kregel answered via video downlink. The downlink, which connected students at JSC, Kennedy Space Center and in Kiev, Ukraine, with the astronauts aboard the Space Shuttle *Columbia* on Dec. 1. **Above:** Kadenyuk works with the *brassica rapa* plants on-orbit using an Optivisor, which provided him a magnified view as he performed the delicate task of pollinating the plants using a bee glued to the end of a toothpick. **Left:** JSC Astronaut Office Education Working Group's Greg Vogt listens intently to the questions and answers while serving as moderator for the JSC student participation. **Below:** The plants get a good start on orbit early in the flight.



S87E-5012